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(54) Anchor bolt

(57) An anchor bolt (10) includes a plastically deformable elongate hollow body (12) defining a fluid-tight chamber (14) within the body (12). A high pressure hydraulic fluid can be charged into the chamber (14) to expand the chamber in a direction transverse to the longitudinal axis of the elongate body (12). By such expansion the chamber walls (36) will bear against the inner wall of a bore to secure the bolt. The pressurising fluid may be of a substance which sets after injection.

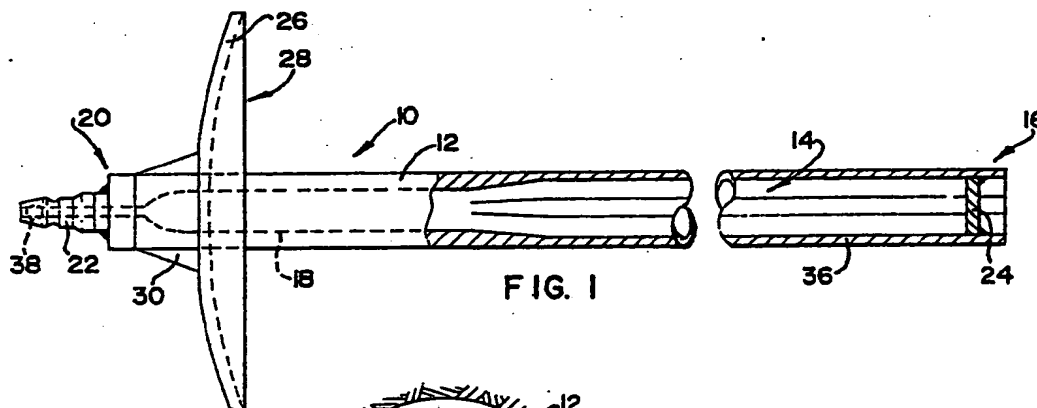


FIG. 1

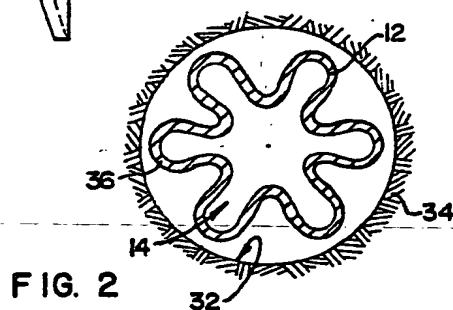
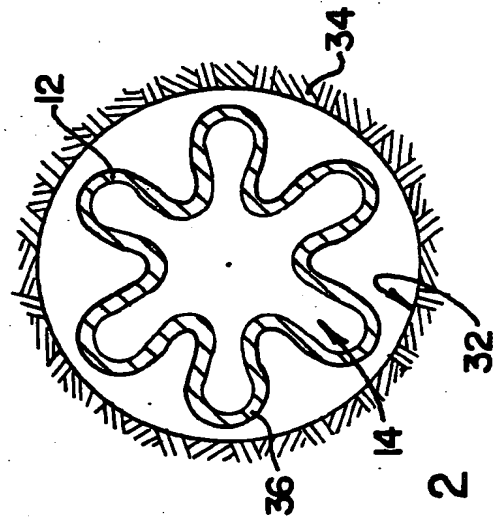
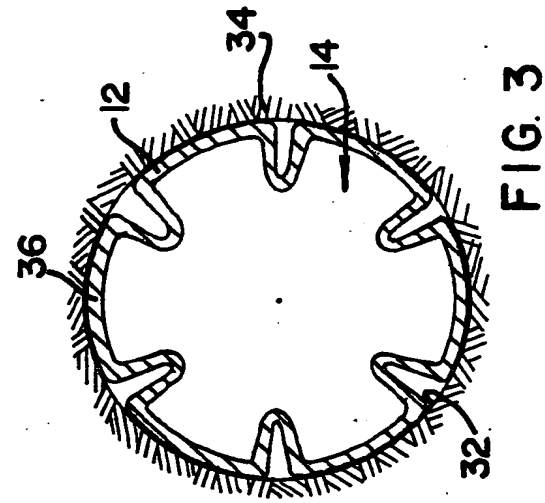
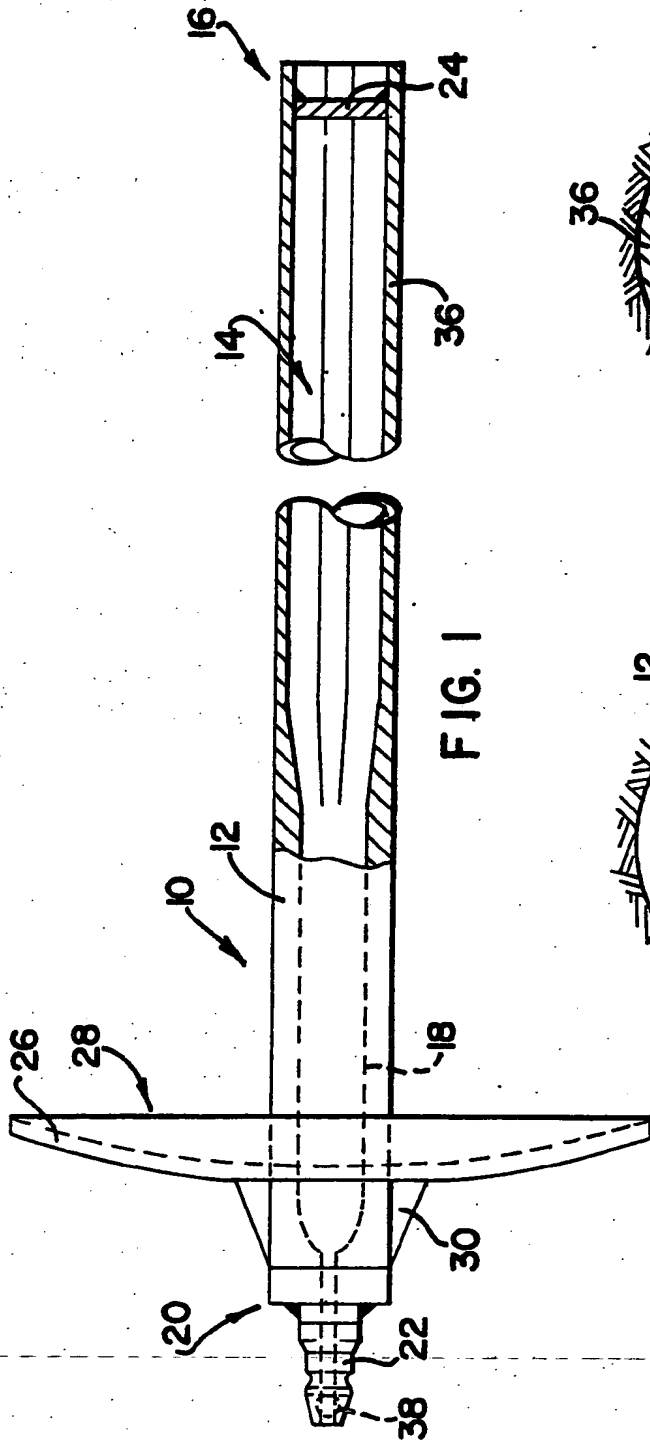
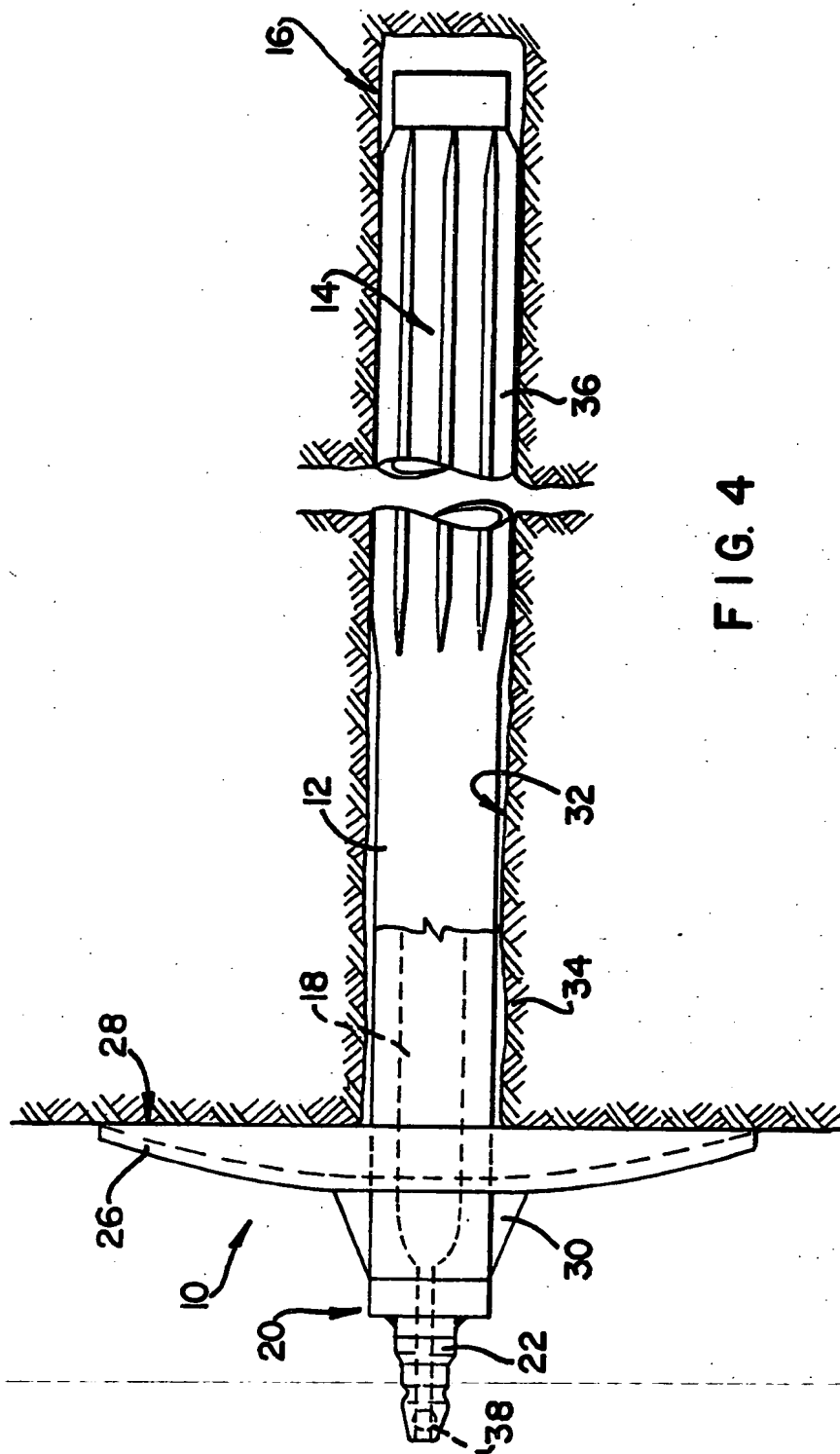


FIG. 2

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SPECIFICATION **An anchor bolt**

This invention relates to an anchoring device. More particularly, the invention relates to an anchoring device for use in supporting a hanging wall in a mine or in like applications.

Anchoring devices of the above kind, hereinafter merely referred to as anchor bolts, generally comprise an elongate rod having an anchoring means disposed near one end of the rod whereby the rod can be secured within a hole in a rockface, or the like. Usually, the end of the rod, opposite to the anchoring means, is provided with a support member defining a shoulder which can abut the rockface when the rod is secured within a hole in the rockface, to thereby effectively support the rockface.

The applicant is aware of various anchoring means that have been suggested and developed for securing a rod of an anchor bolt in a hole. These anchoring means generally include a wedge arrangement having a wedge member which is displaceable to be radially expandible into engagement with the rockface in a hole to thereby locate the rod within the hole.

It is an object of this invention to provide an anchor bolt which is of relatively simple construction and which can be easily and quickly located within a hole in a rockface.

According to the invention there is provided an anchor bolt which includes

a chamber defining means which defines a fluid tight chamber having at least one wall portion which is expandible; and

an inlet means whereby a pressurized fluid may be charged into the chamber.

The chamber defining means may comprise an elongate hollow body defining the chamber along at least a part of its length.

The inlet means may comprise a passage defined in the elongate body leading to the chamber. The anchor bolt may further include a connector means near one end of the elongate body which is in communication with the passage and to which a high pressure fluid supply is connectable.

The connector means may incorporate a non-return valve to prevent the release of pressurized fluid from the chamber defined by the elongate body after pressurization.

Preferable one end of the chamber may extend at least to the end of the elongate body opposite to the connector means.

In a particular arrangement the elongate body, in the region of the chamber defined therein, may have a fluted cross-section. Particularly in this arrangement the chamber may extend along substantially the entire length of the elongate body.

For an anchor bolt receivable, in use, in a bore having a polar axis in a rockface or the like, the chamber may have a wall portion which is expandible in a direction transverse to the polar axis of the bore to thereby securely engage the

inner wall defined by the bore.

In addition the anchor bolt may include a support member defining a shoulder extending transversely from the elongate body for abutting the surface of a wall surrounding a bore within which the elongate body can be secured. The support member may include a washer received freely on and projecting transversely from the elongate body and a stop member secured to the body against which the washer can abut to locate the washer relative to the body.

The washer may be a dished washer with its concave surface being directed towards the chamber defined within the elongate body.

The chamber defining means may particularly be of a plastically deformable material and preferably may be of mild steel.

Further according to the invention there is provided a method of securing an anchor bolt in a bore having a polar axis in a rockface, or the like, in which the anchor bolt includes an elongate body defining a fluid tight chamber along at least a part of the length of the body, which includes the steps of inserting the body into the bore in the rockface and pressurizing the chamber so that it can expand transverse to the polar axis of the bore into engagement with the inner wall of the rockface in the bore to thereby secure the elongate body in the bore.

The method may also include pressurizing the chamber within the body by means of a pressurized hydraulic fluid. The hydraulic fluid may be a settable material which can set after pressurization to provide a rigid interior within the chamber.

Alternatively the method may include filling the chamber with a settable material after pressurization and expansion thereof, and allowing the material to set to thereby provide a rigid interior within the chamber.

The invention is now described, by way of an example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 shows a partially sectioned side view of an anchor bolt, in accordance with the invention;

Figure 2 shows a cross-sectional view of the chamber portion of the anchor bolt of Figure 1 before pressurizing;

Figure 3 shows a cross-sectional end view of the chamber portion of Figure 2 after pressurizing; and

Figure 4 shows a side view of the anchor bolt of Figure 1, when secured in a hole in a rockface.

Referring to the drawings an anchor bolt, in accordance with the invention, is generally indicated by the reference numeral 10. The anchor bolt 10 includes an elongate body 12 defining a fluid tight chamber 14 therein, the chamber 14 extending along substantially the entire length of the elongate body 12 up to the end 16 of the body. A passage 18 leads to the chamber 14 from the end 20 of the elongate body where a connector 22, in communication with the passage 18, is secured. The connector 22 is adapted to receive a

high pressure hydraulic fluid supply means such as a high pressure hose leading from a pump so that a hydraulic fluid under pressure can be fed into the chamber 14.

5 The portion of the elongate body 12 defining the chamber 14 has a fluted cross-section as shown in Figure 2, and an end piece 24 is secured into the end 16 of the body 12 to block-off this end. This fluted portion of the body 12 is adapted to expand radially from the axis of the body 12 when the chamber 14 is pressurized as is hereinafter described.

10 The end 20 of the elongate body 12 further has a dished washer 26 received thereon as shown whereby a shoulder 28 projecting transversely from the body 12 is defined. A conical support 30 is secured to the body 12 and provides a support for the washer 26 for purposes hereinafter described.

20 For securing the anchor bolt 10 in a hole 32 in a rockface 34, the elongate body 12 is inserted into the hole so that the shoulder 28 defined by the washer 26 abuts the rockface 34 surrounding the hole 32. The connector 22 is connected to a high pressure hydraulic fluid supply means (not shown) and the chamber is then pressurized by a hydraulic fluid entering the chamber via the connector 22 and passage 18. As a result of the pressure exerted within the chamber 14, the fluted walls 36 of the chamber are forced to expand radially from the axis of the chamber. This expansion continues until the walls 36 engage the inner wall of the rockface 34 within the hole 32. In this way the elongate body 12 is secured within the hole 32 and the anchor bolt 10 thereby located to support the rockface, which may particularly be a hanging wall in a mine or the like.

35 It must be understood that the expansion of the body 12 resides mainly in the deformation of the chamber walls 26 from their fluted configuration towards a circular configuration. The walls 26 are accordingly not stretched at all and retain their strength in this way. The plastic deformation of the walls are also thereby ensured. It will however be understood that actual stretching of the chamber walls may occur in practice when bolts 10 are secured in holes having a diameter larger than the unfluted diameter of a bolt, but this is not advisable or preferable in the ordinary use of bolts 10.

40 By applying extreme pressures within the chamber 14 the walls 36 of the chamber 14 will conform completely with the wall of the rockface 34 in the hole 32 which it engages. Irregularities in this wall section such as cracks, fissures, indentations or the like are also accommodated and filled to a certain extent by the walls 36 of the chamber and in this way it is ensured that the anchor bolt 10 is properly and permanently secured.

60 The diameter of the body 12 is a bolt 10 will be dependent upon the diameter of a hole into which the bolt is to be secured. It will be understood that prior to use, the diameter of the bolt 10 will be smaller than that of the hole into which the bolt is

to be fitted and that the difference in diameters will be regulated by the exact fluted cross-sectional profile of the chamber which will determine the expansion capabilities of the chamber and the engagement properties of the walls 36 of the chamber with the inner walls of a hole. The ratio between the outer diameter of the body 12 before and after expansion may be up to 1:2 and is preferably approximately 1:1.8. The applicant believes that by suitably varying the fluted profile of the chamber and the wall thickness of the chamber any required engagement properties between the wall of the chamber and the inner wall of a hole can be provided. An anchor bolt 10 can thus be used for hanging walls having different rigidity and brittleness characteristics.

70 It will further be understood that the properties of the anchor bolt 10 can vary according to the length of the chamber 14 within the body 12 of the bolt. This chamber 14 can thus stretch along the entire length of the body of the bolt 10 or along any required section or sections of the bolt 10 as may prove to be most suitable for the particular use of the bolt.

75 In the case of rockface cracking or failures, the dished configuration of the shoulder 26 provides effective tying of the rockface, the gussets 30 ensuring sufficient strength of the washer 28 and thus the shoulder 26, when the bolt 10 comes under tension as a result of such cracking or failures.

80 The elongate body 12 of the anchor bolt 10 is preferably of a plastically deformable material such as mild steel. This will ensure that the chamber 14 does not retract after pressurization and that the bolt 10 is thereby released. For safety purposes a non-return valve 38 may be incorporated into the connector 22 so that the pressure in the chamber can be retained after pressurization.

85 Alternatively, also to prevent retraction of the chamber, a settable material may be pumped into the chamber after pressurization which can then set within the chamber to provide a rigid interior within the chamber. In a particular application the settable material in itself may define the hydraulic fluid for pressurizing the chamber. Conventionally however, a hydraulic fluid such as water or oil may be used for pressurizing the chamber 14.

90 It will be understood that various other embodiments can be envisaged falling within the scope of this invention. Applicant, for example, envisages embodiments in which the elongate body includes an inner rubber tube which can be pressurized and which is surrounded by a metal tubular section which can be expanded upon pressurization of the inner tube to engage a hole within a rockface. The tubular section may include various configurations such as a cage-like configuration, a configuration in which the tubular section is divided in two or more segments by longitudinal slits, or the like.

95 The anchor bolt 10 can be quickly and easily secured in the manner described above.

Engagement between the bolt 10 and the inner walls of a hole can further stretch along the entire length of the bolt and since extreme pressures can be applied, the proper and permanent securement of a bolt 10 is largely ensured and the failure rate of such bolts is accordingly minimised. Securing bolts 10 along the entire length of holes in a rockface also has beneficial aspects in that shearing of bolts along their length due to rock movements need not essentially render the bolts ineffective and engagement forces of the bolt in the rockface can clearly also be minimised if necessary.

CLAIMS

1. An anchor bolt which includes a chamber defining means which defines a fluid tight chamber having at least one wall portion which is expandable; and an inlet means whereby a pressurized fluid may be charged into the chamber.
2. An anchor bolt as claimed in Claim 1, in which the chamber defining means comprises an elongate hollow body defining the chamber along at least a part of its length.
3. An anchor bolt as claimed in Claim 2, in which the inlet means comprises a passage defined in the elongate body leading to the chamber.
4. An anchor bolt as claimed in Claim 3, which includes a connector means near one end of the elongate body which is in communication with the passage and to which a high pressure fluid supply is connectable.
5. An anchor bolt as claimed in Claim 4, in which the connector means incorporates a non-return valve to prevent the release of pressurized fluid from the chamber defined by the elongate body after pressurization.
6. An anchor bolt as claimed in Claim 4 or Claim 5, in which one end of the chamber extends at least to the end of the elongate body opposite to the connector means.
7. An anchor bolt as claimed in any one of Claims 2 to 6, in which the elongate body, in the region of the chamber defined therein, has a fluted cross-section.
8. An anchor bolt as claimed in any one of Claims 2 to 7, in which the chamber extends along substantially the entire length of the elongate body.
9. An anchor bolt as claimed in any one of Claims 2 to 8, receivable, in use, in a bore having a polar axis in a rockface or the like, in which the chamber has a wall portion which is expandable in a direction transverse to the polar axis of the bore to thereby securely engage the inner wall defined by the bore.
10. An anchor bolt as claimed in any one of Claims 2 to 9, which includes a support member defining a shoulder extending transversely from the elongate body for abutting the surface of a wall surrounding a bore within which the elongate body can be secured.
11. An anchor bolt as claimed in Claim 10, in which the support member includes a washer received freely on and projecting transversely from the elongate body and a stop member secured to the body against which the washer can abut to locate the washer relative to the body.
12. An anchor bolt as claimed in Claim 11, in which the washer is a dished washer with its concave surface being directed towards the chamber defined within the elongate body.
13. An anchor bolt as claimed in any one of the preceding claims, in which the chamber defining means is of a plastically deformable material.
14. An anchor bolt as claimed in any one of the preceding claims, in which the chamber defining means is of mild steel.
15. A method of securing an anchor bolt in a bore having a polar axis in a rockface, or the like, in which the anchor bolts includes an elongate body defining a fluid tight chamber along at least a part of the length of the body, which includes the steps of inserting the body into the bore in the rockface and pressurizing the chamber so that it can expand transverse to the polar axis of the bore into engagement with the inner wall of the rockface in the bore to thereby secure the elongate body in the bore.
16. A method as claimed in Claim 15, which includes pressurizing the chamber within the body by means of a pressurized hydraulic fluid.
17. A method as claimed in Claim 16, in which the hydraulic fluid is a settable material which can set after pressurization to provide a rigid interior within the chamber.
18. A method as claimed in Claim 15 or 16, which includes filling the chamber with a settable material after pressurization and expansion thereof, and allowing the material to set to thereby provide a rigid interior within the chamber.
19. An anchor bolt substantially as described in the specification with reference to and as illustrated in the accompanying drawings.
20. A method of securing an anchor bolt in a hole in a rockface or the like, substantially as described in the specification with reference to and as illustrated in the accompanying drawings.